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The Optimal Inequality of Earnings – the Econometric Analysis[**]

Abstract

Our aim is to build an econometric model of growth, in which we will try to estimate the optimum inequality of earnings. By optimum we understand such an inequality of earnings with which the rate of the GDP growth will be the highest. The calculation of the optimum inequality of earnings will be possible by means of the introduction of a variable into the model – the inequality of earnings in a parabolic shape.

We adopted hypothesis that the optimum inequality of earnings exists. If the inequality of earnings is smaller than the optimum one, the most creative, hard working and efficient individuals are not sufficiently paid and motivated to use their abilities in the production process of the GDP. If the inequality of earnings is higher than the optimum one, workers with lower qualifications receive a low pay, which is accompanied by the sense of injustice or even sometimes of exploitation. The sense of injustice and exploitation threatens human bonds, limits trust and social capital. Only the financial factor is a motivations to efficient work. However, there is a lack of full, creative engagement of numerous employees earning below the average pay.

An empirical analysis was conducted for the Polish economy between 1980 and 2004.

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We wrote the introduction and the final remarks together. Part I of the paper was written by J.J. Sztaudynger, part II by P. Kumor. P. Kumor also gathered statistical data.

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Our initial estimation shows that since 1996 the inequality of earnings has been higher than the optimum one and it has been increasing gradually. The greatest setback of the GDP growth caused by an excessive inequality of earnings took place in 2003 and 2004, when it exceeded one half of one percentage point. The outcome seems overestimated unless we assume that the variable represents not only itself but also other variables, for instance the crime rate.

What sense does an optimum inequality of earnings estimated in such way have? As we believe this is the optimum inequality in the sense of the social consciousness and the social sense of justice. If the inequalities in earnings of the most educated and efficient and the least educated and efficient correspond with the social sense of justice then it is the easiest way for a good co-operation, the reinforcement of social bonds, trust and social capital. So it is the inequality of earnings optimum in the sense of the provision of the best social co-operation in the generation of GDP.

We are of the opinion that a similar attitude may be applied in search of the regional optimum GDP per capita inequality, the optimum one in the sense of the maximum increase of the whole country's GDP growth. Similarly one may search for the optimum GDP inequality per capita in a group of countries, such an inequality with which the whole group maximizes its pace of economic growth.

1. Introduction

Our hypothesis is that there is an inequality of earnings (incomes) being optimal for the growth of the economy. If inequality of earnings[1] is smaller than the optimal one the most creative, efficient and effective employees are not remunerated and motivated sufficiently enough to use fully their capacities and skills in economic activities. When earnings of an employee possessing high skills, long years of service in a company, and whose work yields higher than average benefits for a company do not differ considerably from earnings of other employees with low skills and low productivity, the employee can be disappointed[2]. Such situation will lower their work motivation and a desire to improve qualifications.

[1] The inequality will be measured by the Lorenz coefficient.

[2] A.K. Sen, *On Ignorance and Equal Distribution,* "American Economic Review" 1973, vol. 63, pp. 1022 – 1024 (quoted after: S.M. Kot 2000, p. 115).

If inequality of earnings is higher than the optimal inequality, employees with lower skills receive relatively low pay. It can be accompanied by a feeling of injustice being difficult to make objective, and sometimes even by a feeling of exploitation and poverty. The feeling of injustice and exploitation is harmful for social bonds, it weakens ties between employees and employers and lower trust and social capital. An employee receiving low earnings is motivated to work then mainly by a need of satisfying the biological minimum (a survival minimum). Meanwhile, such employees with relatively low earnings do not display creative thinking and involvement in their work.

An employee, who will perceive a relatively big difference when comparing their consumption possibilities and bigger possibilities of other employees, neighbours or acquaintances getting a higher pay, may also experience some disappointment. Such feeling may lead to their lower productivity. Moreover, to make up for too low earnings, such employee will be adopting behaviours being unfavourable for a his company. Such behaviours can be said to include the shortening of working time or using the company's assets for their benefits. Apart from it, during parliamentary or self-government elections such employee will take a decision to cast their vote for parties declaring populist slogans, promising that their living conditions will improve. These can be political parties, which do not necessarily have a good programme of economic growth.

A high inequality of earnings intensifies, on the one hand, a desire to improve one's professional qualifications and, on the other hand, it intensifies a desire to achieve high earnings through personal contacts and acquaintances.

It was our goal to build an economic model of growth and use it in an attempt to estimate a historically optimal inequality of earnings. We consider optimal inequality of earnings as the inequality, at which the labour productivity growth rate would be the highest. Introducing an explanatory variable – inequality of earnings – to the model in a parabolic shape[3] made it possible to estimate the optimal inequality of earnings.

The model was estimated for the Polish economy using 1986–2004 sample.

[3] We chose a parabola as the simplest function having a maximum.

2. Economic growth model making allowances for the inequality of earnings

Economic growth is analysed by means of the labour productivity function. Taking into consideration the impact exerted by two variables: capital/labour ratio and the technical-organisational level, this function assumes the form:

$$GDP_t / L_t = A_t \ f(K_t / L_t), \tag{1}$$

where:

GDP_t / L_t – labour productivity,
L_t – labour,
K_t – fixed capital in constant prices,
K_t / L_t – capital/labour ratio,
A_t – total factor productivity – represents technical-organisational level.

Function (1) can be transformed to the form:

$$\overset{\circ}{GDP_t} / L_t = A_t \ f(\overset{\circ}{K_t} / L_t), \tag{2}$$

where circles above variables denote the rates of growth. If we introduce the rate of investment, which is often done in models of growth, in the place of the capital/labour ratio, then function (2) will take the following form:

$$\overset{\circ}{GDP_t} / L_t = \overset{\circ}{A_t} \ f(I_t / GDP_t), \tag{3}$$

where:

$\overset{\circ}{GDP_t} / L_t$ – labour productivity growth rate,
I_t / GDP_t − investment rate (investment as a percentage of GDP),
A_t − growth rate of total factor productivity (TFP).

Several other factors of growth can be taken into account in the model of growth: rate of inflation, output convergence, human capital, social capital expressed, for example, by means of various inequality measures. These variables were not introduced to model (3). Hence, they are represented by the total factor productivity $\overset{\circ}{A}$, called also the Solow residual[4].

An increasingly big importance in analyses of factors of economic growth is attributed to social capital. Social capital is defined as a degree of a society's organisation through a network of organisations, a set of norms and trust, which are favourable for co-operation, mutual benefits, and which create a potential for solving social problems (C. Sirianni, L. Friedland 1995). When defining social capital P. Sztompka (2002, pp. 222 and 224) stresses that these organisations frequently appear during the process of setting up self-government and voluntary

[4] It should be noted that the size of this residual decreases along with an increasing number of other economic growth factors not taken into account in the model (R.M. Solow 1967, p. 45).

associations and informal groups. The above mentioned trust is supplemented by P. Sztompka with solidarity and loyalty created by friends and networks of contacts. Sztompka emphases that mutual benefits do not only have an economic-financial dimension, but they also include power and prestige (2002, p. 368).

E. Gracia (2002, p. 190) defines social capital as "ability of a society to co-ordinate social entities within a common project. Such co-ordination ability can be based only on shared social values: on the culture of common good". It is pointed out in the above mentioned definitions that social capital paves the way for co-operation of a society, its getting organised or co-ordinated.

Research focussed on social capital has been carried out since the mid-1980s by such scholars as, for instance, R. Putnam, J. Coleman, P. Bourdieu. Social capital cannot be measured directly or in a scalar way, whereas factors which determine it are difficult to measure. Therefore, it was only since the early 1990s that variables, which represent this capital indirectly, have been introduced to econometric models of growth. One of such variables is income (earnings) inequality[5]. The research of impact exerted by earning inequality on economic growth[6] was started in 1993 by O. Galor and J. Zeira (see: F. H. G. Ferreira 1999, p. 8).

For purposes of this study the model of economic growth was supplemented with the Lorenz coefficient:

$$\overset{\circ}{GDP}/L = \overset{\circ}{A} f(I/GDP, LC) \tag{4}$$

LC − measure of income (earnings) inequality, for instance, the Lorenz coefficient.

Two different opinions concerning the impact of income inequality on the economic growth can be found in the literature. One opinion points to its negative impact and the other one – to its positive impact.

However, the opinion about a negative impact of the income inequality on the economic growth rate predominates by far. The mechanism of this impact can be explained as follows:

1. the poorer an average elector is (the median), the higher the taxes are, the stronger are political pressures on redistribution of incomes, the bigger are

[5] Extensive collection of data about income inequalities in several countries can be found on the World Bank's website http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/0,contentMDK:20699070~pagePK:64214825~piPK:64214943~theSitePK:469382,00.html (20.10.2006).

[6] Economists are also interested in a quasi opposite relationship between the influence exerted by the level of earnings on their variations, which can be described by means of the Kuznets curve (F.H.G. Ferreira, 1999, p. II). We will deal with this issue later on.

the disturbances (informal sector, which undermines trust and social capital);

2. growing inequality in earnings lead to social and political conflicts, which has a negative impact on social capital;
3. "poor people may not have the same chances in life as richer people and may thus never quite realize their full productive potential", because, for instance, they do not receive, most frequently, appropriate education or also a loan from a bank;
4. productivity of a poor employee is limited, as they cannot imagine that they can be progressing above a certain level (see: T. Persson and G. Tabellini (1994, pp. 602–604); F.H.G. Ferreira (1999, pp. 9–13); O. Morrissey, J. Mbabazi, C. Milner (2002, pp. 5–7, 17)).

Such negative impact of an initial inequality of earnings on the economic growth rate was confirmed, for example, by T. Persson and G. Tabellini (1994, pp. 607–608) and R.J. Barro in the case of countries with a low GDP[7]. Some other studies and, in particular, those focussed on developed countries, reveal a positive influence exerted by income inequality on economic growth in the medium and short term (R.J. Barro 1999, pp.41–42, O. Morrissey, J. Mbabazi, C. Milner 2002, p. 7 and D. Dollar, A. Kraay 2003, p. 203[8]).

A positive impact can appear in the situation of an insufficient pay (or excessive taxation) of persons being the most productive and effective in the GDP generation process. It is our opinion that small inequality of earnings would stifle the motivation to work more efficiently. In other words, bigger inequality of earnings, when they were too small, will lead – in our opinion – to growth of productivity.

It is possible 'to reconcile' these divergent findings of econometric research if we use a non-linear function having its maximum for describing a relationship between inequality of earnings and economic growth. It will be possible then to estimate the optimal level of this inequality of earnings LC^0, in the sense of maximising the economic growth (J. J. Sztaudynger 2003, pp. 76–77) (see: Figure 1).

[7] R. J. Barro (1999) assumed that the parameter in the case of variations in earnings was increasing along with the GDP parameter. He obtained a negative estimation of the parameter in the case of such variations (inequalities) on the cross section-temporal sample, with this parameter growing along with GDP growth.

[8] Dollar and Kraay make reference to studies carried out by K.J. Forbes in 2000 and those of H. Li and H. Zou in 1998.

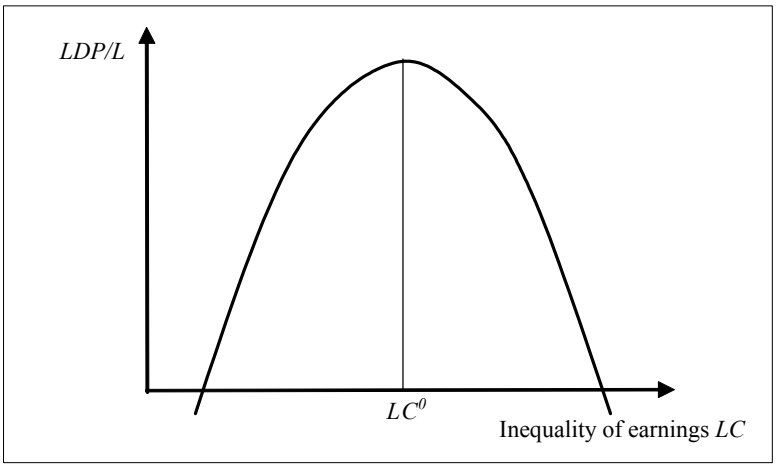

Figure 1. Labour productivity growth rate as a function of inequality of earnings

Source: G.A. Cornia, J. Court (2001, p. 24); J.J. Sztaudynger (2003, p. 76).

3. Estimation of the impact exerted by inequality of earnings on the economic growth

Due to the fact that information about income inequality in Poland is not available we used the Lorenz earning inequality coefficient in our analyses.

Model (4) was estimated on the assumption that inequality of earnings *LC* have a parabolic influence on the economic growth. This hypothesis was verified on the basis of statistical data for Poland during the years 1986–2004[9]. The growth of GDP per an employee is explained (non-linearly) by the investment rate (see: J.J. Sztaudynger 2005, pp. 54–57 and 63–67) and by earning inequality.

[9] For samples starting earlier (in the years 1981–1985) we obtained partly insignificant estimations, which sometimes had opposite signs. The problem of stability of parameters will be analysed by us in further studies and, particularly, from the viewpoint of the increasing Lorenz optimal coefficient.

$$GDP^{\circ}/L = \underset{(2.09)}{0.063}\cdot(I/PKB)^2_{-1} - \underset{(-2.01)}{2.473}\cdot(I/PKB)_{-1} +$$

$$- \underset{(-2.04)}{0.035}\cdot LC^2_{-1} + \underset{(2.17)}{1.995}\cdot LC_{-1} - \underset{(-5.73)}{7.489}\cdot u9091 \qquad (5)$$

$$R^2 = 0.852 \qquad S_e = 1.4$$

where:

GDP°/L − labour productivity growth rate in constant prices per one employee (in %);

$(I/GDP)_{-1}$ − investment rate (one-year lag) in %;

LC_{-1} − Lorenz concentration coefficient of earnings (one-year lag) in %;

the values in brackets denote t-Student statistics.

Model (5) shows that the impact exerted by earning inequality on the labour productivity growth rate has the following form:

$$GDP^{\circ}/L = -0.035\cdot LC^2_{-1} + 1.995\cdot LC_{-1} \qquad (5')$$

Hence, for the value of the Lorenz coefficient *LC* equal to 28.8% the rate of labour productivity growth would reach its maximum.

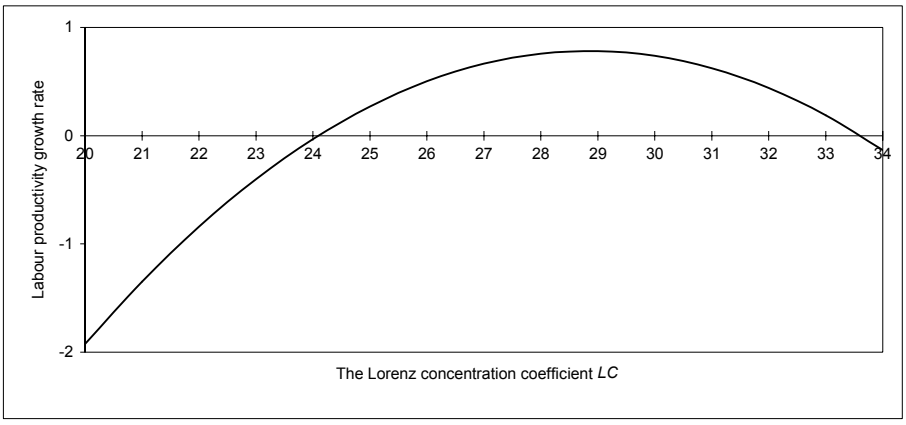

Figure 2. The impact of earnings inequality on the labour productivity growth rate[10]

Source: own calculations on the basis of model (5').

[10] To increase comprehension the graph of the function was shifted down (without changing its shape). This enables to observe better the effects of the changes of earnings inequality.

Summing up the estimations obtained in model (5), it can be seen that:

1. over the years 1986–2004 earnings inequality measured by the Lorenz coefficient exerted an influence on the labour productivity growth rate;
2. the hypothesis about a non-linear – parabolic impact of pay variations on the labour productivity growth was confirmed;
3. in the years 1986–2004 the parabola achieved its maximum for earnings inequality, that is, the Lorenz coefficient equal to about 28.8% – this result is an estimation of optimal earnings inequality in the analysed period assuming that they were stable in that period;
4. significant estimations of the parameters with income inequality confirm that it is admissible to accept an assumption about stability of the optimal income inequality in the years 1986–2004. Effects of dismissing of this assumption will be studied in our further analyses.

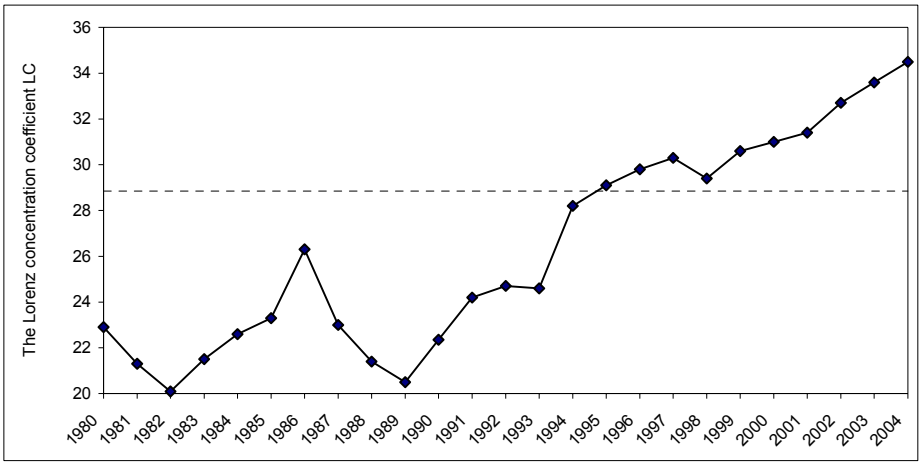

Figure 3. Earnings inequality – Lorenz *LC* coefficient in Poland 1980–2004 (in %)

Source: own calculations based on P. Kumor (2006) and equation (5').

It can be presumed from Figure 3 that:

1. Lorenz concentration coefficient was closest to its optimum value in the years 1994–1998;
2. earnings inequality was too low in the years 1980–1993;
3. in turn, in the years 1999–2004 earnings inequality was too high and they grew, which resulted in a growing slow-down in the economic growth.

Table 1 shows the estimations of a slow-down in labour productivity growth rate being due to the increasing Lorenz coefficient by 1 percentage point

– $\Delta GDP^{\circ}/L$. The analysis was focussed on the values of Lorenz concentration coefficient 28–34, as such values were recorded in the last 10 years in Poland.

Table 1. Estimations of extreme and full slow-downs in GDP growth (in percentage points)[11]

LC	$\Delta GDP^{\circ}/L$	GDP°/L – GDP°/L optimal
	Marginal	Total
28	0.1	0.0
29	0.0	0.0
30	0.0	0.0
31	–0.1	–0.2
32	–0.2	–0.3
33	–0.3	–0.6
34	–0.3	–0.9

GDP°/L – row estimated from model (5').

Source: own estimations.

The estimations in Table 1 indicate that the increase by one unit of value of the Lorenz coefficient from its level of 30 (close to the optimal value) means that the economic growth in the following year will be reduced by about 0.1 of percentage point (thus, it is an influence of a marginal significance). For subsequent higher levels of this coefficient its each subsequent increase by a unit brings about a bigger and bigger reduction of the economic growth. The last column in Table 1 presents estimations of losses in the economic growth resulting from a deviation in the Lorenz concentration coefficient from its optimal value. For instance, for its value equal to 34, a loss in its additional part of the economic growth next year will reach 0.9 of percentage point.

The interpretation made on the basis of historical data concerning pay variations in Poland over the period 1986–2004 can be also interesting, as it allows to estimate the value of such slow-down in the economic year for a definite year. Results of conversions are presented in Table 2.

[11] Losses 0.1–0.2% should be considered insignificant (e.g. in Table 1 and in Table 2).

Table 2. Estimations of slow-down in GDP due to too high or too low earning inequality

Year	Actual GDP°/L	Slow-down of GDP°/L	Year	Actual GDP°/L	Slow-down of GDP°/L
	%	pp.		%	pp.
1986	4.1	–1.1	1996	3.6	0.0
1987	2.3	–0.2	1997	4.2	0.0
1988	5.1	–1.2	1998	5.8	–0.1
1989	2.0	–1.9	1999	6.2	0.0
1990	–6.7	–2.4	2000	7.1	–0.1
1991	–2.8	–1.5	2001	4.4	–0.2
1992	5.4	–0.7	2002	1.9	–0.2
1993	5.4	–0.6	2003	5.1	–0.5
1994	4.0	–0.6	2004	4.7	–0.8
1995	5.6	0.0			

Source: own calculation based on model (5') statistical data, GUS.

For example, the growth of labour productivity in 2004 amounted to about 4.7%. Too big earning inequality recorded in Poland led to a loss in the additional value of this growth. The loss reached about 0.8 percentage point of the growth, which could be achieved. If pay variations in Poland had reached the optimum, it would have been possible to record a higher growth in 2004 amounting to about 5.6 percentage point in all.

Figure 4 contains two lines: the lower line reflecting the real labour productivity growth and the upper line making allowances for the roughly estimated value of growth if earning inequality had been at their optimum level. It should be noted that a major slow-down in growth was observed in the years 1986–1990, that is, before the economic system change. The losses were due to too small earning inequality. On the other hand, the losses after the year 2000 resulted from too big earning inequality (see: Figure 3) and they tended to increase.

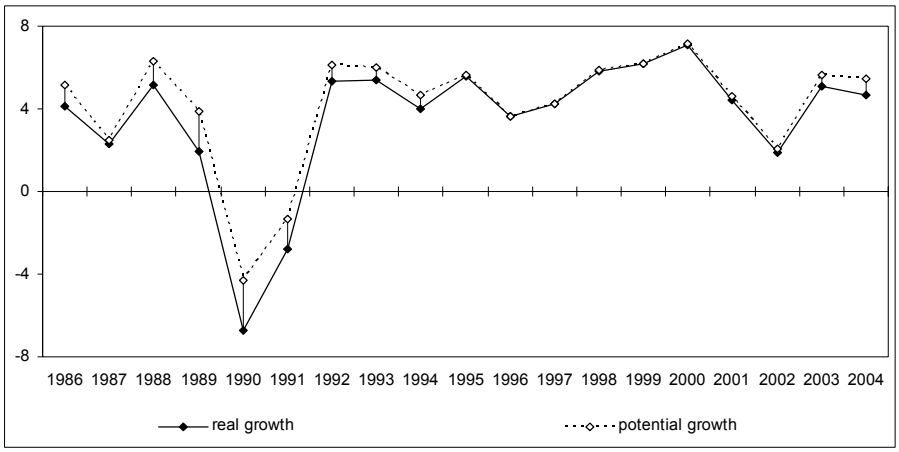

Figure 4. Growth of labour productivity: actual and potential (assuming optimal inequality of earning LC_{opt})

Source: own estimations made on the basis of Table 2.

Final remarks

The question asked in this article: *whether inequalities in earnings are too big and they slow down Poland's economic growth?* is socially and economically important. However, it cannot be answered fully convincingly on the basis of our still only initial and containing errors calculations. On the other hand, we are certain that the presented research findings are sufficiently statistically significant. So, it can be stated with a great deal of probability that the proposed method creates a chance for estimating optimal inequalities of earnings (incomes).

Our initial estimations show that the slow-down in labour productivity growth caused by too big inequality in earnings in 2003 reached about 0.5 percentage point and 0.8 percentage point in 2004.

Our estimations of effects of a too big inequality in earnings were much higher in the function explaining GDP growth rate. They amounted to 1.4 and 2.2 of percentage points, respectively (P. Kumor, J. J. Sztaudynger 2007).

We suppose that it is due to cuts in employment accompanying a drop in GDP. It causes that a drop in labour productivity is smaller than a drop in GDP[12].

A new research question appears here. Does a lower than optimal inequality in earnings reduces employment? We expect that such is the case. Too big inequalities in earnings worsen relationships between partners in the labour market, which finds reflection in a smaller readiness to be employed and to recruit new employees both on the employee's and the employer's side.

As we have already said we intend to upgrade the model replacing earning inequalities with income inequalities, which reflect better the disproportion in the population's living standards.

Another question, which arises here, concerns the sense of optimal inequalities estimated in such a way. In our opinion it is an optimal inequality from the viewpoint of social awareness and social feeling of justice. If earning inequality of the best educated and efficient employees and those of the least educated and efficient employees reflect the social feeling of justice, then it is easiest to co-operate successfully, strengthen social bonds, trust and social capital. Thus, it is the optimal inequality in the sense of ensuring the best co-operation of a society in the GDP generation process.

We have accepted an assumption in our studies that optimal earning inequality constant in time and space. Since optimal earning inequality result from the social sense of justice, their changes seem to be probable[13].

We will be verifying a hypothesis saying that optimal (income) earning inequality grows. On the other hand, we do not know how the growth of optimal earning inequality could be limited. However, we are sure that optimal income inequality have a strong cultural and historical context. We can expect regional and, in particular, international differences.

We have not dealt in our article with the question who should reduce inequality in incomes. Some role can be played here by the tax system with its proper progression. Research of household incomes carried out by E. Aksman indicates that an effect of redistribution of incomes in Poland in the years 2000–2002 was the lowering of inequalities in earnings (measured by the Gini coefficient) on average by 14.2% (E. Aksman 2005, pp. 769–782).

A social discussion should also be important. We are proposing the following arguments, which should convince employees with the highest

[12] Although employment appears in the GDP in the form of an explanatory function, but with a parameter estimated at a significantly lower level than a unit (0.76).

[13] We have tried to introduce a variable to the model such as the increase of earning inequality to reflect a hypothesis that the bigger the change in these variations the lower the social tolerance for this change. However, this variable was insignificant.

earnings: if they agree to reduce inequalities in pay or, for example, reduce their future earning aspirations (appetites), then an additional economic growth will take place, in which they will also participate. In the situation when earning inequality departs considerably from the optimal value, participation in an additional economic growth can compensate losses resulting from the lowering of inequalities in earnings[14]. An additional argument can be the lowering of crime rate resulting from smaller income inequality confirmed by many studies (R.J. Barro 2003, P. Fajnzylber, D. Lederman, N. Loayza 2002, M. Sztaudynger 2004).

As the parabola is relatively flat at the top the Lorenz coefficient should be limited to 32 near its maximum, because its further reduction will not result in a significant acceleration of economic growth.

A search for optimal income inequality variations for the economic growth is a search for economic effectiveness understood in such way. The question which arises here is whether such reasoning, in which effectiveness (inequalities being optimal for economic growth) prevail over justice, can be considered proper. The answer to this question is sought by T. Kwarciński (2006, p. 3). He points out that the problem formulated in such way has a normative character and its solving „... depends, to a large extent, on acceptance of definite evaluation judgements". Kwarciński (2006, p. 18) quotes Rowles's opinion, according to which „social and economic inequalities should assume their form ..., which would benefit most those most handicapped..." Kwarciński comes to a conclusion that it is admissible to subordinate justice to effectiveness provided additional effects obtained in this way will improve the situation of the poorest people. We intend to deal with this issue in our further studies.

The last question we wish to ask is whether a similar approach can be used in the search for an optimal inequality in per capita GDP in regions (administrative provinces; optimal in the sense of maximising GDP growth rate in the whole country. A similar optimal inequality in per capita GDP can be sought in a group of countries – such inequality in which the whole group maximises its economic growth rate.

[14] This argument will certainly not be convincing for persons with high earnings.

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